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HELMINTHS FROM THE SONORAN SPOTTED WHIPTAIL, *CNEMIDOPHORUS SONORAE*, AND THE WESTERN WHIPTAIL, *CNEMIDOPHORUS TIGRIS* (SAURIA: TEIIDAE), FROM SOUTHERN ARIZONA WITH COMMENTS ON *ABBREVIATA TERRAPENIS* (NEMATODA: PHYSALOPTERIDAE)

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Key words: Cnemidophorus sonorae, Cnemidophorus tigris, *Teiidae, helminths, Nematoda, Cestoda, Acanthocephala, Arizona.*

Cnemidophorus sonorae Lowe and Wright, 1964, the Sonoran spotted whiptail, occurs from southeastern Arizona to northeastern Sonora and east to western New Mexico; *Cnemidophorus tigris* Baird and Girard, 1852, the western whiptail, ranges from Oregon and Idaho south through California to Baja California and Coahuila, México, and eastward to western Colorado, New Mexico, and Texas (Stebbins 1985). Helminths have been previously reported from *Cnemidophorus sonorae* by McAllister (1992) and *Cnemidophorus tigris* by Grundmann (1959), Babero and Matthias (1967), Telford (1970), Specian and Ubelaker (1974a, 1974b), Benes (1985), and Lyon (1986).

Abbreviata terrapenis (Hill 1945) Morgan, 1945 was originally described from specimens taken from 7 ornate box turtles (*Terrapene ornata*) collected from widely separated points in Oklahoma (Hill 1945). The 1st lizard host to be reported for this helminth was *Sceloporus jarrovii*, also collected from widely separated points in Arizona, New Mexico, and México (Goldberg et al. 1995, 1996). The purpose of this paper is to report on a helminthological examination of *Cnemidophorus sonorae* and *Cnemidophorus tigris* from southern Arizona and the presence of *A. terrapenis* in these 2 additional lizard hosts.

Twenty-one female *Cnemidophorus sonorae* (mean snout-vent length [SVL] = 73.2 mm ± 5.6 *s*, range 60–80) and 82 *Cnemidophorus tigris* (28 females, 54 males; mean SVL = 65.6 mm ± 10.1 *s*, range 34–82 mm) were borrowed from the herpetology collections of the Natural History Museum of Los Angeles County (LACM) and the University of Arizona (UAZ) and examined; collection data are given in the Appendix. The lizards were originally preserved in 10% formalin or Bouin's fixative and stored in 70% ethanol. The body cavity was opened and the gastrointestinal tract was excised by cutting across the esophagus and rectum. The esophagus, stomach, small intestines, and large intestines were slit longitudinally and examined separately under a dissecting microscope. The body cavity and liver were also examined. Each helminth was removed and initially placed in a drop of glycerol on a glass slide. Nematodes were identified from these temporary mounts. Cestodes were stained with hematoxylin, mounted in balsam, and identified. Acanthocephalans were cleared in xylene, mounted in balsam, and assigned to genus. Terminology usage is in accordance with Margolis et al. (1982).

Cnemidophorus sonorae was found to harbor 2 species of cestodes, *Oochoristica bivitellobata* Loewen, 1940 and *O. macallisteri* Bursey and Goldberg, 1996; and 3 species of nematodes, *Abbreviata terrapenis*, *Pharyngodon warneri* Harwood, 1932, and *Thubunaea cnemidophorus* Babero and Matthias, 1967. *Cnemidophorus tigris* was found to harbor 1 species of cestode, *O. bivitellobata*; 2 species of nematodes, *A. terrapenis* and *P. warneri;* and cystacanths of a species of Acanthocephala, *Centrorhynchus* sp. Prevalences and mean intensities for these helminths are given in Table 1. The infection prevalence between males and females of *C. tigris* was not significantly different (for *A. terrapenis*, $\chi^2 = 0.17$, 1 df, $P > 0.05$; for *P.*

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TABLE 1. Gastrointestinal helminths of 21 *Cnemidophorus sonorae* and 82 *C. tigris* from Pima County, AZ.

Helminth	*Cnemidophorus sonorae*			*Cnemidophorus tigris*		
	Prevalence (%)	Mean intensity (range)	Site[1]	Prevalence (%)	Mean intensity (range)	Site[1]
Oochoristica bivitellobata	5	6.0	c	1	3.0	c
Oochoristica macallisteri	5[2]	2.0	c	—	—	—
Abbreviata terrapenis	76[2]	8.0 (1–24)	a,b	86[2]	14.3 (1–61)	a,b,c,d
Pharyngodon warneri	14[2]	22.7 (4–55)	c,d	42	50.3 (1–220)	d
Thubunaea cnemidophorus	5[2]	2.0	b	—	—	—
Centrorhynchus sp.	—	—	—	4	1.0	b

[1]a = esophagus, b = stomach, c = small intestine, d = large intestine
[2]new host record

warneri, $\chi^2 = 0.21$, 1 df, $P > 0.05$). *Cnemidophorus sonorae* is a new host record for *O. macallisteri*, *A. terrapenis*, *P. warneri*, and *T. cnemidophorus; C. tigris* is a new host record for *A. terrapenis*. Helminths were placed in vials of alcohol and deposited in the U.S. National Parasite Collection (USNPC), Beltsville, Maryland (accession numbers in Appendix).

Oochoristica bivitellobata, *Pharyngodon warneri*, and *Thubunaea cnemidophorus* have been previously reported in North American lizards (Table 2) and may be limited to teiid lizards. The occurrence of *T. cnemidophorus* in the crotalid snakes *Crotalus cerastes*, *C. mitchelli*, and *C. scutulatus* by Babero and Emmerson (1974) needs further study to determine if the snakes are indeed hosts, or if the parasites were present in lizards that the snakes had ingested. McAllister (1992) questioned the determination of *O. bivitellobata* in *Sceloporus undulatus* and suggested that it probably is *Oochoristica scelopori;* thus, *S. undulatus* is not included in Table 2. Species of *Centrorhynchus* typically use arthropods (probably insects) as intermediate hosts and primarily birds of prey as definitive hosts (Petrochenko 1958). The occasional presence of a cystacanth in the stomach of an insectivore could be expected. One nematode not found in these lizards, but frequently associated with teiid lizards, is *Parathelandros texanus* Specian and Ubelaker, 1974. This helminth may be limited to west Texas (see Baker 1987).

This is the first report of adult *Abbreviata terrapenis* from teiid lizards, although larvae of *Abbreviata* sp. have been reported from *C. sexlineatus* by McAllister, Trauth, and Conn (1991). Larvae of *Abbreviata* sp. have also been reported from the crotaphytid lizard *Crotaphytus collaris* and the phrynosomatid lizard *Sceloporus undulatus* (Morgan 1941, McAllister and Trauth 1985). Adults of *Abbreviata terrapenis* have previously been reported from *Sceloporus jarrovii* in Arizona, New Mexico, and México (Goldberg et al. 1995, 1996). This is also the 1st report of *O. macallisteri* from a teiid lizard, although unidentified species of *Oochoristica* have been reported from *Cnemidophorus dixoni*, *C. gularis*, and *C. tesselatus* (McAllister 1990a, 1990d, McAllister, Cordes, and Walker 1991). In Arizona, Benes (1985) reported *Oochoristica* from *Cnemidophorus tigris*, *Coleonyx variegatus*, *Phrynosoma solare*, *Sceloporus magister*, and *Uta stansburiana*, but did not identify the species.

Abbreviata terrapenis is a heteroxenous physalopterid helminth with an indirect life cycle involving an insect intermediate host (Anderson 1992). Echternacht (1967) reported that termites are the major dietary component for *C. sonorae* and *C. tigris* from the Santa Rita Mountains, Pima County, Arizona, representing over 90% of all prey organisms consumed. Mitchell (1979) reported a predominance of termites in the diets of *C. sonorae* and *C. tigris* in Cochise County, southeastern Arizona. Vitt and Ohmart (1977) similarly found that termites compose 76% of the diet of *C. tigris* living along the Colorado River in western Arizona. Pianka (1970) reported that, while southern *C. tigris* populations eat large quantities of termites, northern populations (Idaho, Nevada, Utah) utilize other food types and consume few termites. If termites serve as intermediate hosts for *Abbreviata terrapenis*, low frequencies of these insects in the diets of *C. tigris* from northern populations might account for the absence of *A. terrapenis* in the studies of these populations by Grundmann (1959), Babero and Matthias (1967), and Lyon (1986).

TABLE 2. Reports of *Oochoristica bivitellobata*, *Pharyngodon warneri*, and *Thubunaea cnemidophorus* from teiid lizards.

Helminth	Host	Locality	Prevalence	Reference
Oochoristica bivitellobata	*Cnemidophorus burti*	Arizona	1/57 (2%)	Goldberg and Bursey 1989
	C. dixoni	Texas	9/58 (16%)	McAllister, Cordes, and Walker 1991
	C. exsanguis	New Mexico, Texas	7/87 (8%)	McAllister 1990c
	C. flagellicaudus	New Mexico	5/23 (22%)	McAllister 1992
	C. gularis	New Mexico, Texas	3/289 (1%)	McAllister 1990d
		Texas	1/83 (1%)	McAllister et al. 1995
	C. hyperythrus	California	5/104 (5%)	Bostic 1965
	C. inornatus	Arizona	10/78 (13%)	Goldberg and Bursey 1990
	C. neomexicanus	New Mexico, Texas	7/61 (11%)	McAllister 1990b
	C. sexlineatus	Kansas	91/144 (63%)	Loewen 1940
		Nebraska	3/3 (100%)	Brooks and Mayes 1976
			2/64 (3%)	Shoop and Janovy 1978
		South Dakota	13/23 (57%)	Dyer 1971
	C. sonorae	Arizona	1/16 (6%)	McAllister 1992
	C. tesselatus	Texas	3/27 (11%)	McAllister 1990a
	C. tigris	California	13/49 (27%)	Telford 1970
		Idaho	13/32 (41%)	Lyon 1986
		Nevada	5/97 (5%)	Babero and Matthias 1967
		Utah	5/7 (71%)	Grundmann 1959
	C. uniparens	Arizona	8/31 (26%)	Goldberg and Bursey 1990
	C. velox	Colorado	not stated	Douglas 1966
		New Mexico	2/37 (5%)	McAllister 1992
Pharyngodon warneri	*C. exsanguis*	New Mexico, Texas	10/87 (11%)	McAllister 1990c
	C. gularis	Oklahoma, Texas, Mexico	69/289 (24%)	McAllister 1990d
		Texas	2/83 (2%)	McAllister et al. 1995
	C. inornatus	Arizona	18/78 (23%)	Goldberg and Bursey 1990
		Texas	not stated	Specian and Ubelaker 1974a
	C. laredoensis	Texas	5/22 (23%)	McAllister et al. 1986
	C. neomexicanus	New Mexico, Texas	2/61 (3%)	McAllister 1990b
	C. sexlineatus	Texas	2/4 (50%)	Harwood 1932
		South Dakota	19/23 (83%)	Dyer 1971
		Arkansas	15/51 (29%)	McAllister, Trauth, and Conn 1991
	C. tesselatus	Texas	4/27 (15%)	McAllister 1990a
	C. tigris	Utah	5/7 (71%)	Grundmann 1959
		Arizona, Nevada	63/100 (63%)	Babero and Matthias 1967
Thubunaea cnemidophorus	*C. tigris*	Nevada	9/87 (10%)	Babero and Matthias 1967
	C. burti	Arizona	2/57 (4%)	Goldberg and Bursey 1989
	C. sexlineatus	Arkansas	3/51 (6%)	McAllister, Trauth, and Conn 1991

It has been shown that *Skrjabinoptera phrynosoma*, also a member of the Physalopteridae and a common parasite of *Phrynosoma* spp., is dependent upon ants (*Pogonomyrmex* sp.) as intermediate hosts (Lee 1957). The possibility that termites may serve as intermediate hosts of *A. terrapenis* needs to be investigated. Such information would be helpful in determining distribution patterns of *A. terrapenis*.

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APPENDIX
MUSEUM ACCESSION NUMBERS

University of Arizona

Cnemidophorus sonorae (N = 21 [all females]) Sabino Canyon (883 m elevation, 32°20′N, 110°49′W), Santa Catalina Mountains, Pima County, Arizona, collected 1953 (UAZ 4810–12, 4861), 1960 (10903, 10971), 1961 (11034), 1964 (15252, 15258, 15471, 15541, 15708), 1967–1969 (20666–67, 20677, 20681, 20687, 29637, 30087, 30090, 30682).

Natural History Museum of Los Angeles County

Cnemidophorus tigris (N = 77 [27 females, 50 males]) foothills Santa Catalina Mountains (822 m elevation, 32°20′N, 110°07′W), Pima County, Arizona, collected 1962 (LACM 143588), 1963 (LACM 143587, 143589), 1964 (LACM 143590–93), 1966 (LACM 143586, 143594–634), 1969 (LACM 143558–85); (N = 5 [1 female, 4 males]) Avra Valley (457 m elevation, 32°20′N, 111°20′W), Pima County, collected 1964 (LACM 14365–69).

U.S. National Parasite Collection

Cnemidophorus sonorae: *Oochoristica bivitellobata*, 86861; *Oochoristica macallisteri*, 86862; *Abbreviata terrapenis*, 86863; *Pharyngodon warneri*, 86864; *Thubunaea cnemidophorus*, 86865.

Cnemidophorus tigris: *Oochoristica bivitellobata*, 86866; *Abbreviata terrapenis*, 86867; *Pharyngodon warneri*, 86868; *Centrorhynchus* sp. (cystacanth), 86869.